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mud, were found partly melted. Arica this time wholly escaped, although the shocks were felt all over Peru. In 1831, after nearly a century's rest from any fatal shocks, Arica was destroyed for the fifth or sixth time since the landing of the Spaniards, some three hundred years since. These are only the most severe shocks which have disturbed this region. Others, that anywhere else would attract attention, here pass almost unnoticed. Indeed it has been said that the Andes are continually quaking in some part, although severe shocks have seldom visited the eastern slope.

The volcanoes nearest the cities of Arica and Arequipa are of great height; *Sahama*, near the former, being 23,914 feet, while *Miste*, near the latter, is 18,877 feet high, and frequently in gentle eruption.

With such an array of terrible results, it would be hard here to insist, with any chance of being believed, that earthquakes are, by no means, nuisances, and, that on the contrary, they are portions of God's operations in Nature most beneficial and useful. The tides of the ocean are useful, that every one knows, although they leave bare and pestilent marshes and flats; and these irregular tides of the land have none the less their uses in breaking up and altering the surface of the earth, changing watercourses, altering the shoreline, and in other ways, whose description can hardly be condensed into the limits of this article.

REVIEWS.

THE VARIATION OF ANIMALS AND PLANTS UNDER DOMESTICATION.*— These volumes are the first of the suite promised by the author in his work on the "Origin of Species," and are filled with facts of his own observa-

*The Variation of Animals and Plants under Domestication. By Charles Darwin. Authorized (American) Edition, with a Preface by Professor Asa Gray. 2 vols, 12mo, pp. 494 and 500. Published by Orange Judd & Co., 245 Broadway, New York.

tion, and extensive quotations from all the authorities upon the various races of domesticated animals. The author's general argument may be inadequately given as follows: That since "all organic beings increase at so high a ratio, that no district, no station, not even the whole surface of the land or the whole ocean, would hold the progeny of a single pair after a certain number of generations," "the inevitable result is an ever-recurrent struggle for existence." In other words, a contest for growing and feeding room in which "the strongest ultimately prevail, the weakest fail." "If, then, organic beings in a state of nature, vary even in a slight degree," "the severe and often-recurrent struggle for existence will determine that those variations, however slight, which are favorable, shall be preserved or selected, and those which are unfavorable shall be destroyed." Thus if by any chance a male is born stronger than his fellows, he will prevail in the battles of the breeding season, and raise offspring having a certain advantage, also, over their fellows in point of strength, and thus this variation will gradually accumulate until the peculiarity which distinguished only one individual, becomes common over large areas, and perhaps universal to the species.

Again if an individual vary in any way which may give it a better chance of surviving in the general struggle, this variation is likely to become permanent, since a greater number of this favored race would survive and transmit their peculiarities to their offspring. Thus a constant progress is maintained, the structures varying and gradually departing from their original types by this infinitely slow process of improvement by evolution, until new species, new genera, and new families arise. This process is called natural selection, showing that nature does her work of progressive improvement in organic beings, as the breeder does among domesticated animals, by the destruction or exclusion of the inferior individuals, and the pairing together only of the strongest and best.

Darwin's opponents say on the other hand, that a species is an invariable type, and that the variation of individuals does not accumulate, but fluctuates between certain limits. The inevitable conclusion being that there is no progress by the evolution of one form out of another, but that each species is a creation directly from the hands of God.

The anti-Darwinists lay great stress upon the tendency of cultivated plants and animals, especially when allowed to run wild, to revert, in their characteristic markings, to the original wild types. We are disappointed that so little is said upon this point in the volumes under review Unquestionably the doctrine of reversion bears two interpretations in the present state of our knowledge, according as one considers it subordinate or more powerful than the tendency to variation. The anti-Darwinist takes the last view, and attributes the different races of domestic animals, with their great anatomical differences, to the power exercised by man in rendering tendency to reversion powerless while he increases the tendency to variation; thus artificially sustaining and producing races which could not have occurred under the action of natural

laws, since among wild animals the two tendencies would mutually counteract each other, keeping the species within its own proper boundaries of form and variation.

The only really notable instance about which the author seems to entertain no doubt, is the Porto Santo rabbit. This animal, though differently marked in some respects, and not more than half the weight of the English rabbit, yet recovered the peculiar markings of the English species in rather less than four years after its transportation to England. Thus in a feral state, under a different climate, it lost the characteristic colors and weight of its species, and returned to the colors only when brought to its native climate. They were found while in the Zoölogical Gardens to be extremely wild and active, more like large rats in this respect than rabbits, and untamable; and the two males, though bachelors, utterly refused to pair with the native breeds; "yet this rabbit, which there can be little doubt would thus have been ranked as a distinct species, has certainly originated since the year 1420."

One would think that an instance of this kind would unquestionably prove the efficiency of change of climate, and the external surroundings of the species in producing a revolution in its characteristics. Natural selection could have had nothing to do with the return of the characteristic markings of the species after its return to England, since they were the same individuals, and not their offspring, which reverted. Yet, Darwin (p. 337) is disposed to attribute the change which took place when the species was transported to Porto Santo, rather as due to reversion and natural selection, than to change of climate. If so, why did change of climate produce the reversion to its ancestral colors when it was transported to England, and why is the hot insular climate of Porto Santo deemed inadequate to produce a similar result? A cause similar to that which produced the change of color in so short a time, would certainly seem adequate to produce the change of size and habit in the time which elapsed since the year 1420.

The proposition that the laws which govern the propagation and inheritance of characteristics among domesticated races, are the same as those which obtain among wild animals, is supported by a classification of the pigeons, in which the several stocks are traced back through intermediate types to Columba livia. The author, also, adds that in this classification "the same difficulties are encountered and the same rules have to be followed as in the classification of any natural but difficult group of organic beings." The novelty of the fact, however, consists in this, that the several races, the Pouter, Fantail, Carrier, etc., differing from each other to an extent which only those who have seen them can appreciate, are traced, with more or less probability, back to one common ancestor. Perhaps none of Darwin's experiments and researches will excite the attention of the systematic zoölogist more than this. That man has been unable to destroy the laws of affinity as they exist among natural groups, while he has so radically modified the form and character of the original species, is a significant fact. If true, we can no longer assert that man

can reverse or denaturalize the action of these laws among domesticated animals, but simply change the direction of their action. Thus he may make them produce any given series of forms which are possible in the organization of the progenitor, but all these forms will be related to each other, and must be classified in the same way as a natural series of feral animals.

In the second volume, after showing that inheritance of structure and habits must be considered the rule, except when "overborne by hostile conditions of life, by incessantly recurring variability and by reversion," the author states this very important law. "At whatever period of life a new character first appears, it generally remains latent in the offspring until a corresponding age is attained, and then it is developed. When this rule fails, the child generally exhibits the character at an earlier period than the parent. On this principle of inheritance at corresponding periods, we can understand how it is that most animals display from the germ to maturity such a marvellous succession of characters."

Naturalists universally acknowledge that, during their development, animals pass through certain changes or stages of growth, during which they acquire characteristics resembling the peculiarities of the adults of more simply organized species. This law has hitherto only been ascertained in the larger groups in a general way, or if applied to smaller groups has been used only to settle disputed points of classification. In an article recently published, Mr. Hyatt has applied this embryological law to the classification of the fossil Ammonoids, even to species of closely allied genera.*

His observations, however, differ, having been made upon species instead of individuals, in this important particular: namely, that which is accidental with the immediate offspring, the earlier appearance of a new characteristic, is the law and not the exception between the species, and in some quite closely allied shells, such as *Androgynoceras hybridum*, *A. appressum*, *Liparoceras Henleyi*, and *L. Beechei*, certain characteristics are developed at earlier periods in each succeeding species of the series, and finally omitted altogether. This and similar instances led him to the conclusion that "the young of higher species are constantly accelerating their development, and reducing to a more and more embryonic condition, or passing entirely over the stages of growth corresponding to the adult periods of preceding or lower species." We should look, therefore, upon this earlier occurrence of characteristics, among individuals, not as an accident, but as probably a law. Without it we cannot see how any room, on the basis of Darwin's theories, can be obtained in the life of any individual or species, for bringing to maturity those characteristics which especially mark it as an advance in the line of progress.

To account for the various phenomena of the inheritance of character, features, diseases, and injuries at corresponding ages in the offspring, and reversions, we have the doctrine of Pangenesis.

* Memoirs of the Boston Society of Natural History. Vol. I, Part II. On the Parallelism of the Individual and Order in Tetrabranchiate Cephalopods. By A. Hyatt.

According to this theory, each cell in every part of an animal is supposed to be capable of throwing off an infinite number of gemmules, or organic units, at every stage of its development. These gemmules are conveyed from the parents to the embryo through the medium of the sperm and ovule. In this way the development of characteristics, at corresponding ages, is readily accounted for. These gemmules are capable only of producing cells like those from which they were derived, and thus they continue to live in the circulation until the proper age for their development into cells enables them to join in building up the body. They would then be drawn together, as we understand it, by a sort of natural affinity, and reproduce the tissues of the part from which they were derived. Under adverse circumstances, certain classes of these would not be developed but lie dormant in the organization, though still transmitted from parent to child, until in some remote individual they would find the proper opportunity for development, and produce a reversion. While this theory appears to satisfy nearly all the conditions of inheritance, there are certain cases which Mr. Darwin, with his usual candor, admits are inexplicable. Those instances in which certain varieties of plants can be propagated by buds, but revert in the seedling, this occurring especially with hybrids, and "certain plants with variegated leaves, phloxes with striped flowers, barberries with seedless fruit, can all be securely propagated by the buds or cuttings; but the buds developed from the roots of these cuttings almost invariably lose their character, and revert to their former condition."

It is the misfortune of a science in the transition stage of its history that all theories can only be approximations to the truth. The old and the new theories of life are no exceptions to this rule, and the minds of naturalists are distracted by two views, apparently equally uncertain. Darwin, with all his erudition and extensive research, is unable to remove the main difficulty in the way of the doctrine of evolution. He is obliged, in his "Origin of Species," to assume the miraculous creation of four primary types, and only by analogy does he consider himself justified in referring these four types back to one common ancestor. This part of the argument he candidly confesses is weak and unreliable. Darwin, also, wisely avoids any reference to the origin of life itself, and when he has arrived at the four primary types, and even by analogy at their single progenitor, the reader is still as far as ever from knowing where and how they came into being.

As yet, all attempts to produce living beings, of even the lowest organization, from inorganic compounds have failed, and in all cases where spontaneous generation is said to have occurred, the Bacteriums, Monads, etc., have appeared in a fluid which was impregnated with some vitalized compound.* Life is not necessarily extinguished by the heat to which these fluids were subjected, or else why is it that cooked food, which has been subjected to any heat short of absolute combustion, is capable of convey-

* A Word on the Origin of Life. By Professor J. D. Dana. Silliman's Journal, May 1866.

ing more or less of its former store of vitalized matter into the digestive organs? These experiments, however, do not justify the unbiassed mind in coming to any conclusion. They have been made with great care and thoroughness, but until a series of similar attempts, with all the modern appliances and safeguards, has been tried upon matter which is not derived in any way from previously vitalized compounds, it is not safe to say either that life can or cannot be produced by spontaneous generation. The key-note to the theory of the origin of species, the doctrine of evolution, would appear to be the origin of life, the beginning of evolution, and this theory, however true it may be in its minor applications, is very far from completion when it rests upon a basis of four primary types, or even one whose origin is doubtful.

On the other hand, the theory of miraculous creation, by which it is believed that every species is separately created, rests upon negative evidence. It is alleged that the ancestry of no one species has as yet been traced to a specifically distinct progenitor, and that the same species do not usually cross any of the great gaps in geological time, thus giving to each set of beings, which successively inhabited the surface of the earth, the appearance of a new, independent creation.

These two, grand, negative arguments, are the buttresses of the theory, but it is hardly necessary to say that they are not conclusive. The basis they afford is liable to be shifted by any new investigation, since it is not inherently improbable that species may have specifically distinct progenitors, or that they pass from one geological formation to the other, but only the first has not been traced, and the last is still a disputed question.

To complete the elements of confusion and uncertainty, we have no fixed meaning to the word species, which is the key-note to the dispute. While all know that a naturalist means a certain initial division, all the members of which are *supposed* to be, on account of their resemblance to each other, the descendants of a common ancestor, there is no test of this consanguinity. It thus becomes in practice a matter of personal judgment, whether we select a larger or a smaller initial division, and call it a species, though it makes a vast difference in the result. If we regard slight differences as sufficient to characterize the species, we are drawn towards the view that each is separately created; if, however, greater latitude is given, the varying forms thus supposed to have a common ancestry are strong supporters of Darwin, and his laws of inherited variability. It is, perhaps, this uncertainty, and the desire of almost all minds of the nineteenth century, to look for secondary causes, whose modes of action may be determined by experiment, rather than to refer to the direct interposition of the Creator, that has caused so many converts to Darwinism.

The present volumes are, besides their value to the philosophical naturalist, a condensed statement of facts with regard to domesticated animals, and bring the agriculturist and zoölogist face to face in a way which we cannot but hope will prove beneficial to both. Whatever may be the errors of theory, the facts are judiciously classified, faithfully and can-

didly given, both for and against the author's opinions, and cannot but prove of great value to every unprejudiced reader.

In conclusion we may remark that no fear of scientific technicalities need deter any one from procuring these volumes. They convey a vast amount of instruction in a thoroughly comprehensible garb.

FIELD, FOREST, AND GARDEN BOTANY.*—We are glad to be able to announce the approaching issue (if not already in the market) of a work upon botany, of a character so likely to meet the wants of amateurs, whether botanists or gardeners, as well as of those who make either botany or gardening a profession, and indeed of every one who likes to know the name of a common plant of our region, either wild or cultivated. It is a book from which everything is left out that is not directly conducive to the easy determination of the name of a plant we may happen to have in hand, and one in which all reasonable facilities, in the way of copious Analytical Keys, Index, and typographical arrangement are introduced for this very purpose. Although 2,650 species, under 947 genera, are described with more or less of detail, yet those who use this book must not be disappointed if they do not find the rarer native plants mentioned. They must turn to the "Manual" for those, and it would be unreasonable to suppose that every plant from foreign parts, which we may cultivate, is described in a book of less than 400 pages. As already intimated, however, all our common wild plants which are worthy of notice, and all the more generally cultivated garden and hot-house plants, are here described in terms, from which, so far as it is possible, all technicalities are eliminated, and all synonymy is left out.

A special advantage that the book offers is, that it will enable students and teachers of botany to use in their study and teaching, exotic plants which will often present forms of structure that are not represented at all in our fields and woods, or even introduce the knowledge of whole natural orders, which are otherwise beyond their reach, without recourse to extensive botanical libraries. The use of this book will also enable the study to be carried on in winter with much greater facility than ever before.

Another feature of the work will be very acceptable to many persons, and that is the part concerning the ferns, contributed by Professor Eaton of Yale College. All our common native ferns, as well as those usually cultivated, are described so as to be easily determined by any one who is familiar with the meanings of the few technical terms necessarily used, and who reads with care the characters of the Natural Order.

As the author says in his Preface, "the great difficulties of the undertaking have been to keep the book within the proper compass, by a rigid exclusion of all extraneous and unnecessary matter, and to deter-

*Field, Forest, and Garden Botany; a simple introduction to the common plants of the United States, east of the Mississippi, both wild and cultivated. By Asa Gray, Fisher Professor of Natural History in Harvard University. New York: Ivison, Phinney, Blakeman & Co. Chicago: S. C. Griggs & Co. 1868. (Reviewed from advance sheets.)